

SECTION 1.0

INTRODUCTION

The national airspace system is operated by the Federal Aviation Administration(FAA) to serve a variety of users with different operational roles, missions and needs. Users include commercial air transport operators, general aviation, business aviation, military aviation, air taxi operators, helicopter operators, and other user groups. These operators are considered the end users of the National Airspace System (NAS) and are supported by air traffic service controllers and specialists who operate and maintain the NAS subsystems in basic functional areas including:

- _ Communications
- _ Weather
- _ Surveillance
- _ Automation
- _ Maintenance & Operations
- _ Navigation & Landing

Within these functional areas, users conduct flights in phases generally described by operational domains. These operational domains encompass a myriad of user roles, missions, and interdependent uses of the airspace. This document focuses on the following operational domains:

- _ Tower/Airport Surface
- _ Terminal
- _ En Route
- _ Oceanic
- _ Flight Services
- _ National Traffic Flow Management
- _ Airborne/Aircraft

The goal of the FAA is to ensure the safe, efficient utilization of the NAS to meet the needs and support all categories of user operations within the national airspace. A secondary goal is to promote the safety and efficiency of air traffic control systems and airspace use globally.

Since air travel is continuing to increase and NAS modernization is well underway, there will be an increasing need to reduce and eliminate NAS capacity constraints, delays and controller work load, and to improve flight and system efficiency. Because radio communication between controllers and specialists on the ground and pilots operating aircraft is the single most critical element of the NAS communications system, the air-to-ground (A/G) system must be capable of providing reliable and timely communications throughout the NAS. In the future, new technology will provide more accurate, timely, and precise communications capabilities,

not only for voice, but for data communications between pilots and controllers as well. As the needs of the users change and the age of the current system increases, there is an increasingly important need to promote critical change and improvements to the A/G communications system.

Highlights of these emerging NAS changes include the following:

- _ New aircraft are entering the aviation fleet bringing into the NAS new capabilities;

- _ New procedures are being developed to accommodate traffic trends, growth, and increasing operating costs for users;

- _ New products and services are being developed for navigation, weather and surveillance; new communications techniques (specifically digital voice and data link) are being implemented and developed to provide data and graphics to the pilot en route; and,

- _ Automation tools and systems are being implemented.

All of these changes will promote significant enhancements to today's NAS A/G communications requirements.

This operational concept describes current and envisioned A/G system operations and user needs for communications as these needs relate to the evolution of the NAS. The future air/ground communications system is inextricably linked to rapidly evolving technology which will be applied to user needs as these needs evolve and become defined.

1.1 Scope

This future Very High Frequency (VHF) Air/Ground Systems Operational Concept document is prepared for the FAA ASE-200. It is to be used for long-range planning activities as well as the point of departure for all flow-down documentation for the system. The operational concept document also identifies shortfalls and ensures that FAA addresses all issues relating to the system. The customer, potential users, operators and maintainers, designers, system integrators, and all contributors to the completed system are the audience to whom the document is directed.

1.2 References

This document relies heavily on fundamental materials already established which describe key elements of the current and future A/G system. These include:

The Mission Needs Statement (MNS), entitled "The Next Generation A/G Communications System"²⁸;

The requirements established from the "VHF Air-Ground Communications System Improvements Alternatives Study and Selection of Proposals for Future Actions," RTCA SC-172²⁶; and

The data link operations descriptions provided from "The Aeronautical Data Link System Vision: The Key to Future Air Traffic Services"⁴⁵; The Aeronautical Data Link Operational Concept⁴⁶; and "Operations Concepts for Data Link Applications of Flight Information Services: An Approach, the Products, the Issues," RTCA SC-169.³⁷

There are many additional reference materials and documents which provide critical descriptions of technical and operational issues and factors which will drive both technological capabilities and offerings, as well as operational needs and requirements. The reference materials of significance are listed as Appendix A to this document.

1.3 Purpose

The purpose of this operational concept is to provide a common operational and user (pilots) perspective of the Future Digital VHF Air/Ground (A/G) Communications System. The concept provides a description of the current and future needs of users and operators of the A/G system; describes the current and future operational environments; and identifies current and future user and operator roles, procedures, capabilities, and basic operating principles. As these needs and operations are evolutionary and tied to the implementation of new technological capabilities, the operational concept will periodically be modified to reflect changes to operational and user needs and technological opportunities.

The operations concept is intended to:

- _ Determine the relative priority of need for, and benefits resulting from, a new digital voice and data air/ground system;
- _ Identify critical unresolved issues concerning system support capabilities, roles, and responsibilities;
- _ Ensure that industry efforts to develop standards and Minimum Operational Performance Standards (MOPS) for supporting new avionics are properly focused; and
- _ Provide a basis for establishing user support and commitment for the Future Digital Very High Frequency (VHF) Air/Ground (A/G) Communications System.

A transition specification for the Future Digital VHF Air/Ground (A/G) Communications System is not included in this preliminary document. While planning for the transition to the Future Digital VHF A/G Communications System is ongoing, there are many key issues which have been identified in Section 2.0 that will

require completion at a later date. The following issues are noted as criteria which must be considered:

_ Will controllers and pilots utilize the new capabilities by voice, by request/reply data link or by broadcast data link? Will multiple data links be available as a result of the institution of this new technology system?

_ How will the communications system transition from its current analog version to an all-digital system with no visible operational changes?

_ How will the upgraded NAS components handle the digital voice and data communications in the future?

_ What are the frequency management requirements for all users in all flight regimes with the digital radio?

1.4 A/G System Mission Needs

There is a growing need to replace the current communications system. An ever-increasing demand for aircraft communications services has created both domestic and international capacity problems. The key deficiencies of the current communications system are discussed in the FAA's Mission Needs Statement (MNS-137) which was approved by the Agency on October 5, 1994. The following provides a list of the significant problems which will be resolved when the upgrade from an analog, voice-only VHF A/G communications system to the Future Digital VHF A/G Communications System is completed. The MNS describes current system deficiencies and identifies planned improvements to be made through the implementation of the Future Digital VHF A/G Communications System. Generally, the needed improvements required to mitigate shortfalls within the current system include the following six categories:

1. A/G Communications System Capacity
2. A/G Communications Infrastructure Support
3. No Data Link Capability
4. Susceptibility to Radio Frequency Interference
5. No Security Mechanism to Guard Against Unauthorized Users
6. Other Deficiencies

The detailed discussion of these deficiencies and planned improvements are provided in Section 2.0, System Description. The following describes the rationale for change and the primary and secondary mission objectives.

Air Traffic Control (ATC) is the primary interface between the FAA and users of the nation's airspace. ATC comprises many distinct services. The primary service is the communication of safety-critical ATC instructions including passage of requests, instructions, and advisory reports between pilots and air traffic controllers and specialists via remote A/G radios. A/G addressed

communications will make use of several possible data links including VHF Data Link (VDL), Mode S, and satellite data link. The next generation A/G communications system supporting the above mission must satisfy current voice requirements and be defined consistent with stated strategic plans and goals including the following :

- _ Improve performance to meet future voice and data requirements;
- _ Improve telecommunications cost-effectiveness of air traffic services (ATS)
operation (air traffic and flight information services);
- _ Convert to a predominantly digital system;
- _ Implement integrated communications architecture; and
- _ Continue to implement a system based on international standards.²³

The goals must be accomplished while maintaining safety and accommodating growing traffic demand. In maintaining safety of air traffic, the A/G communications used for real-time control of the aircraft must be able to support current operational functions to the users and be available on a continuous basis.

The FAA requires a new A/G radio communications system in order to:

- _ Provide sufficient spectrum capacity in the VHF A/G communications band;
- _ Replace increasingly difficult and expensive to maintain VHF/Ultra High
Frequency (UHF) analog radios;
- _ Overcome shortcomings of the existing analog AM radio system, including
susceptibility to radio frequency interference and lack of security mechanisms;
- _ Provide a data link capability to satisfy ATC requirements;
- _ Improve operational performance characteristics; and
- _ Provide additional features to satisfy the A/G communications requirements
identified by FAA.

The primary mission of the Future Digital VHF A/G Communications System includes the following objectives:

- _ Ensure that A/G communications system capacity will meet demand for A/G communications services through:

- a. Increased A/G communication capacity
- b. More efficient use of A/G communications system capacity

_ Upgrade the communications infrastructure through:

- a. Increased flexibility of ground system
- b. Intrinsic system back-up
- c. Replacement of obsolete equipment

_ Provide improved voice and data communication through:

- a. Improved operational performance
- b. Improved access to A/G communications
- c. Reduce user workload
- d. Improve voice quality over a degraded channel

1.5 FAA Planning Process

To facilitate and encourage user community interaction in the development of planned and proposed improvements to the NAS, a series of "vision" documents have been issued. These white papers provide details on operational and technical issues necessary to achieve the FAA Air Traffic Management (ATM) vision. The FAA vision places increasing reliance on advanced automation capabilities in ground and airborne systems and requires the communication and management of timely and accurate air traffic/flight information and navigation/surveillance data in all operational domains. Digital data communications will become the primary means of exchanging information among NAS users and the supporting automation and communications systems.

The A/G communications planning and management process will consist of four major products, which are:

1. **Vision Paper:** A high-level discussion of the evolution and long-term communications goals contained in "FAA Concepts and Description of the Future ATM System of the US."⁴¹

2. **Operational Concept:** A concept of capabilities, procedures, and needs of the A/G communications system. This operational concept describes how user operations and needs will transition as the concepts and goals of the FAA vision are met. The Operational Concept is essential to guiding system development by identifying user operational needs to be satisfied through the provisions stated in the System Plan.

3. **System Plan:** A discussion of programs and systems needed to implement user operational needs provided in "Development of Communications Systems in the Future US Air Traffic Management System."⁴³ It provides a realistic plan for implementing programs and systems in a timely manner as the FAA moves from the current system to the envisioned system.

4. Management Plan: A management approach to addressing A/G communications needs, including identification of agency stakeholders, team building, and goal setting.

The relative hierarchy of these four documents is depicted in Figure 1-1.

Figure 1-1. Air/Ground System Planning Document Hierarchy

1.6 Document Organization

This preliminary operational concept document is organized to provide a detailed description of the current and future A/G systems (Section 2.0) and operational scenarios (Section 5.0) which provides illustrative depictions of how the future A/G system will support controllers and pilots communications for all operational domains. These two sections are of particular importance since near-term Agency planning and design for the new system are dependent upon user acceptance and support for proposed system capabilities, features, and benefits. This preliminary document serves as phase one of a two-phased effort to develop a comprehensive operational concept for the Future Digital VHF A/G Communications System.

Section 2.0 is organized to present the current A/G system, its architecture, system elements, interfaces, and drivers for change. This section also describes in a parallel structure the future A/G system, its architecture, elements, interfaces, and the features which respond to the deficiencies in the current system. Finally, Section 2.0 presents a general description of the transition issues to be addressed as the evolution of the future system becomes defined. Since many key transition issues are yet to be determined, it is not possible to present detailed transition scenarios.

Section 5.0 provides a description of controller operations using the Future Digital VHF A/G Communications System in all operational domains. This section also provides user scenarios for commercial air transport operations and general aviation operations for all domains. Illustrations are used to present complex voice and data communications between controllers and pilots.

The remaining sections (Section 3.0, Support Environments; Section 4.0, User and Operator Definition; and Section 6.0, Operational Modes) are to be provided at a future date.